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CONTENTS

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ANNUAL MEETING

of

The Potato Association of America

In Conjunction With

American Institute of Biological Sciences

UNIVERSITY OF WISCONSIN, MADISON, WISCONSIN

September 7-8-9, 1953

– INFORMATION ON HOUSING –

DORMITORY ACCOMMODATION: University Dormitories will be available for housing. Couples and families will be accommodated in hotels, motels and private homes near the campus.

DORMITORY ROOMS MAY BE OCCUPIED: Any time from noon on Sunday, September 6th until 10 a.m. on Friday, September 11th.

COST OF ROOM AND MEALS PER PERSON IN DORMITORIES: Sunday evening to Thursday including breakfast: $21.50. Deductions for luncheons and banquets scheduled by Societies will be made. For those occupying dormitories for shorter periods some adjustment will be made.

RESERVATIONS: May be made from July 1st to September 5th. Payments may be made at check-in time in dormitories and by arrangement in off-campus housing.

HOTELS: Reservations may be made at the following Madison hotels: Loraine, Belmont, Park and Edgewater. Rates are $3.50 up. Rates at motels are $5.00 up.

ACKNOWLEDGMENT: Each advance dormitory reservation will be acknowledged by a postcard which should be presented at the registration desk in September. Registration will be in the Wisconsin Memorial Union, Langdon Street.

TO MAKE ADVANCE REGISTRATION: Please fill out the registration form below and mail to: Otto E. Mueller, Director, University Housing Bureau, 434 Sterling Court, Madison, Wisconsin.

(Please type all information)

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(surname) (first)

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Title: .... Institution: ....

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Full Names, Sex, Relationship of Members of My Party: ....

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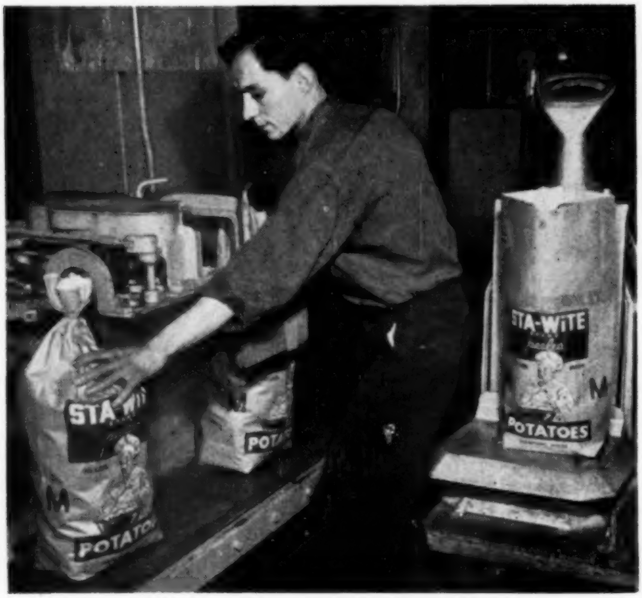
Expected Time of Arrival.............................. Of Departure: ....

Society Membership: ....



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American Potato Journal

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FUSARIUM TUBER ROTS OF LATE POTATOES AS RELATED TO INJURIES AND CERTAIN CHEMICAL TREATMENTS[1]

J. M. LUTZ[2]

INTRODUCTION

Fusarium tuber rots (dry rots), most of which start at injuries made during harvesting and storing the late potato crop, usually constitute the principal loss by disease in storage (1, 6). The studies reported herein were undertaken primarily to determine the relative seriousness of different types of injuries as avenues of infection by species of *Fusarium*. Also the comparative value of certain chemicals for control of Fusarium tuber rots was investigated. Some of these had been reported to control Fusarium rot of gladiolus (4, 5) whereas others had been reported to have value in controlling Fusarium tuber rot of potatoes (1, 2, 3).

INFLUENCE OF TYPE AND DEGREE OF INJURY ON TUBER ROTS

At time of harvest (October 3 to 25, 1950 and October 6 to 17, 1951) approximately 35 pounds of sound and a similar quantity of potatoes with each type of injury listed in table 1 were selected from 5 lots of potatoes in 1950 and from 4 lots in 1951. These potatoes were stored in bushel crates placed in a commercial storage. In 1950 the temperature was gradually lowered from approximately 55°F. in early October to approximately 50° by the end of the month and to 40° by the end of November. It was maintained at 36° to 40° for the remainder of the storage period. Relative humidity was about 75 per cent in October and about 85 per cent subsequently in both years. In 1951 the temperature was about 58° until October 22, when it started dropping, and it reached 40° by November 5. It was maintained at 36° to 40° until the last 2 weeks of the storage period, when it was gradually increased to 48°.

The potatoes harvested in 1950 were examined for decay on April 18, 1951, and those harvested in 1951 on April 28, 1952.

At time of harvest, a potato was considered as being slightly bruised or cut if it was within the tolerance for U. S. No. 1 grade but not for U. S. Fancy, moderately bruised or cut if it was within the tolerance for U. S. No. 2 potatoes but not for U. S. No. 1, and badly skinned if more than 25 per cent of the skin was gone.

The per cent rot (based on weight of tubers affected) which developed in potatoes with various types and degrees of injury is given in table 1. Nearly two-thirds of the potatoes with moderate digger cuts and over one-third of the potatoes with slight cuts (within the tolerance for U. S. No. 1 grade) rotted. Bruises also were important avenues of infection for fusarium rot fungi. About one-third of the

[1]Accepted for publication April 21, 1953.
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TABLE 1.—*Amount of Fusarium tuber rot in relation to type and degree of injury.*

Lot No.	Date of Harvest	Variety	Rot in Storage of Potatoes					
			Sound	Badly Skinned	Slightly Bruised	Moderately Bruised	With Slight Digger Cuts	With Moderate Digger Cuts
			Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
1	Oct. 3, 1950	Red Pontiac	0	0	13	42	20	39
2	Oct. 10, 1950	Pontiac	4	6	11	30	32	74
3	Oct. 19, 1950	Red Pontiac	2	2	5	53	20	55
4	Oct. 24, 1950	Pontiac	4	5	5	18	17	51
5	Oct. 25, 1950	Pontiac	2	6	9	10	30	61
6	Oct. 6, 1951	Triumph	1	8	4	15	10	24
7	Oct. 15, 1951	Red Pontiac	1	0	11	40	66	97
8	Oct. 17, 1951	Triumph	18	18	26	77	92	99
9	Oct. 17, 1951	Red Pontiac	0	11	1	20	38	64
		Average	3.6	6.2	9.4	33.9	36.1	62.7

potatoes with moderate bruises and slightly less than one-tenth of those with slight bruises rotted in storage whereas less than 4 per cent of the apparently sound potatoes rotted. More badly skinned than sound potatoes rotted but the difference was not statistically different.

Influence of Certain Chemicals on Tuber Rots

Lots of potatoes from seven different growers selected because of their high incidence of mechanical injury or scald spots were chemically treated. Five lots of potatoes were treated in October 1950 and inspected April 19, 1951. The other 2 lots were treated October 17, 1951, and inspected April 28, 1952. Temperatures and humidity conditions during storage were the same as those previously described (page 131). One bushel of each of the 7 lots was used for each chemical treatment, making 7 bushels per treatment.

Fusarex and methyl ester of napthalene acetic acid (MENA) were used as supplied by the manufacturer. Sufficient pyrax was added to all other materials to make 41 grams of the mixture per bushel of potatoes. Approximately the same amount of material (applied as a dust) was shaken on each layer of potatoes as they were placed in the Kraft-paper-lined bushel crates in which they were stored.

The results given in table 2, which are based on percentage of tubers showing rot, show no important reduction of Fusarium tuber rot in storage by any of the treatments. In addition to the chemicals listed in table 2, thymol was used at rates of 5 and 10 grams per bushel in 1950 and 1 and 2 grams in 1951. The 5- and 10-gram treatments injured the potatoes to such an extent that they completely rotted. The potatoes given 1- and 2-gram treatments kept no better than the untreated checks.

TABLE 2.—*Fusarium tuber rot of potatoes as influenced by various chemicals (average of 7 lots).*

Chemical Treatment	Rate of Application	Tuber Rot
	Grams Per Bushel	Per cent
None	None	10.1
Fusarex	136	13.1
Arasan	8[1]	9.4
Dithane Z-78	4[1]	8.9
Arasan (2 parts) + Dithane Z-78 (1 part)	12[1]	10.1
Fermate	4[1]	10.7
Spergon	20.5[1]	10.5
MENA	41	12.0

[1] Sufficient pyrax was added to make 41 grams of mixture per bushel.

Summary

Potatoes with digger cuts and bruises were much more susceptible to Fusarium tuber rots than tubers without these defects. Digger cuts made potatoes more susceptible to rot than did bruises. None of the chemical treatments tested was effective in reducing storage rots.

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DILUTION CURVE OF A RING-SPOT STRAIN OF POTATO VIRUS X[1]

S. P. Raychaudhuri[2]

Ladeburg, Larson, and Walker (3) studied the ring-spot strains of virus X. The activity of a similar ring-spot type of virus X was measured indirectly in different concentrations by the local-lesion method (1).

The virus, maintained in *Nicotiana glutinosa* L. in a greenhouse, was kindly supplied by Dr. F. O. Holmes. *Gomphrena globosa* L. plants were raised from healthy seeds obtained from Dr. A. F. Ross, Cornell University, Ithaca, New York. These (Figure 1) were used as indicator plants (2). Extracts from young diseased leaves of *N. glutinosa* were obtained by grinding the latter in a mortar with a pestle. The extracts were squeezed through cheesecloth and centrifuged at 3500 r.p.m. for 5 minutes in order to obtain a clarified supernatant fluid. This fluid was the stock virus extract for each experiment and different dilutions were made of it with distilled water. Since leaves of *G. globosa* are rather narrow, opposite leaves instead of half leaves were inoculated with two different concentrations of the virus. A glass spatula wrapped with cheesecloth was used for inoculations. During inoculation, each leaf was held in position by using a clean, flat, wooden pot label on the back of the leaf and the whole of the upper surface of the leaf was rubbed by one gentle and uniform stroke of the spatula previously dipped in the inoculum. Three experiments were conducted with batches of *G. globosa* plants, 33 days, 35 days, and 32 days old, respectively. Inoculated plants were maintained in a greenhouse at 20° to 25° C.

[1]Accepted for publication February 16, 1953.
From the Laboratories of the Rockefeller Institute for Medical Research, New York, N. Y.

[2]Visiting Investigator, the Laboratories of the Rockefeller Institute for Medical Research, New York, on study leave from the Indian Agricultural Research Institute, New Delhi, India.

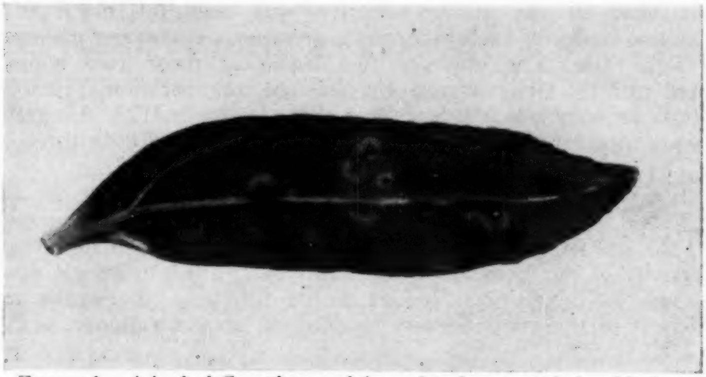

FIGURE 1.—A leaf of *Gomphrena globosa* showing necrotic local lesions. (Photograph by J. A. Carlile.)

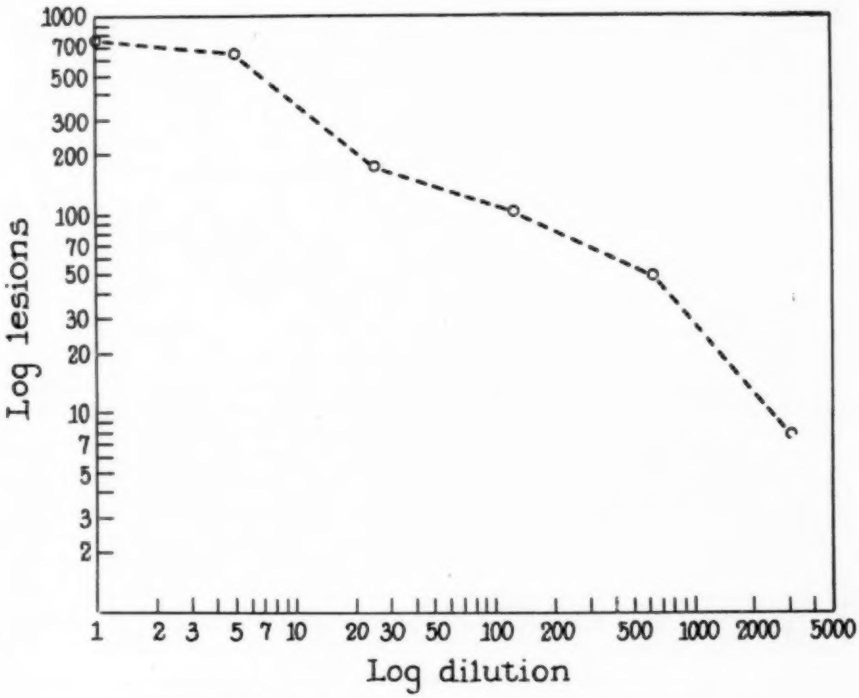

FIGURE 2.—Dilution curve of a ring-spot strain of virus X.

The virus at the desired dilution was used for inoculating two leaves at two nodes of each vigorously growing *Gomphrena globosa* plant of the same size. The opposite two leaves at those two nodes were inoculated with the virus extract of a different concentration. The following concentrations were used: 1:5, 1:25, 1:125, 1:625, 1:3125. Altogether, 20 leaves were inoculated with the virus at each concentration in three experiments. The results are shown in figure 2.

The results obtained in these tests showed that there is a sharp decline in the activity of this strain of potato virus X when diluted from 1:5 to 1:25 and from 1:625 to 1:3125. These data give an idea regarding the infectivity of the virus at certain dilutions. By the technique employed in these tests no definite conclusions can be drawn as regards the accurate measurement of the virus activity at different concentrations.

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Acknowledgments

Thanks are due to Dr. L. O. Kunkel and Dr. F. O. Holmes, of the Laboratories of the Rockefeller Institute for Medical Research, New York, for their interest in the work and to Dr. E. S. Schultz, Principal Pathologist, U. S. Department of Agriculture, Beltsville, Maryland, for helpful criticisms.

POTATO FIELD RESEARCH MEETINGS

Place: Rhinelander, Wisconsin and vicinity
Sturgeon Bay, Wisconsin

Time: August 31 — September 4

The next annual meeting of the Potato Association of America will be held September 7-9 at Madison, Wisconsin, along with 18 other biological societies, under the auspices of the American Institute of Biological Sciences (A.I.B.S.).

Two special field research meetings have been arranged. One will be held near Rhinelander, Wisconsin, on August 31 and September 1 to go over the research plots at the Starks Farms, breeding material at the University Potato Breeding Farm, and seed stocks at the State Potato Foundation Farm. Accommodations at the State Forestry Camp "Trees for Tomorrow" near Eagle River have been arranged. The second meeting will be held near Sturgeon Bay, Wisconsin, on September 3 and 4 to review the collection of tuber-bearing Solanum species being maintained in the Inter-Regional Potato Introduction Program.

Please let me know on or before July 1 whether you will attend the field meetings, inasmuch as accommodations at Eagle River and Sturgeon Bay are limited.

R. H. Larson, *Chairman*, Field Research Meeting Committee
203 Horticulture Bldg., University of Wisconsin
Madison 6, Wisconsin

THE HISTORY AND DEVELOPMENT OF THE ETHYLENE BISDITHIOCARBAMATE FUNGICIDES[1]

GORDON A. BRANDES[2]

Most potato growers of the United States east of the Rocky Mountains are familiar with the new organic fungicide "nabam," (disodium ethylene bisdithiocarbamate) and "zineb", (zinc ethylene bisdithiocarbamate). The use of these compounds has had a unique and rapid development on potatoes. Today they are used on approximately 75 per cent of the U. S. acreage of this crop which is regularly treated for blight control.

The ethylene bisdithiocarbamate fungicides demonstrate high fungicidal activity over a wide range of plant pathogens with a generally good margin of safety to a variety of plant types. Ferbam (ferric dimethyl dithiocarbamate), ziram (zinc dimethyl dithiocarbamate) and thiram (tetra methyl thiuram disulfide) are more limited in their fungicidal activity, or plant safety, and their commercial development has been somewhat more restricted. Ferbam is used mostly on apples, tobacco and ornamentals; ziram for certain diseases of tomatoes and other vegetables; whereas thiram is used largely as a seed protectant.

Dr. W. F. Hester of the Rohm & Haas Company Research Department first prepared "nabam" coded He-175 and "zineb" coded He-178 and other salts of ethylene bisdithiocarbamic acid in 1935. Early tests to establish the fungicidal value of these compounds were conducted at the Rohm and Haas Research Department. (3)

The fungicidal properties of He-175 were confirmed in 1941 by Dimond, Heuberger, and Horsfall at the Connecticut Agricultural Experiment Station under a Crop Protection Institute fellowship sponsored by the Rohm and Haas Company. (1)

He-175 had high fungicidal potency but was water soluble and was variable in its field performance. This lead to explorations of ways to prepare relatively insoluble salts which would be more stable and resistant to weathering. Early attempts to prepare dry insoluble salts with good physical properties met with considerable difficulty.

In 1943 Dr. J. W. Heuberger, who had since joined the staff of Delaware Experiment Station and T. F. Manns (4) added zinc sulfate and lime to He-175 in the spray tank. This mixture precipitated zinc ethylene bisdithiocarbamate which is virtually insoluble and relatively stable and gave excellent control of late blight of potatoes.

Dr. J. D. Ruehle (5) of the Sub-tropical Experiment Station, Homestead, Florida, and Dr. L. Hill of Rohm and Haas confirmed Heuberger's results with He-175 plus zinc sulfate and lime under severe late blight conditions on potatoes in the winter of 1943-1944. He-175 not only gave better control of late blight than the standard copper materials but also gave an increase in yield of more than 100 bushels per acre. About this same time further studies by the research and production chemists indicated a liquid form of disodium ethylene bisdithiocarbamate to be more uniform and stable than the original He-175 powder. The new liquid product was

[1]Accepted for publication April 20, 1953.
[2]Agricultural and Sanitary Chemicals Department, Rohm & Haas Company, Philadelphia 5, Pa.

brought out in 1944 and given the trade name Dithane D-14. The common name, nabam, has now been assigned to this product. The use of lime in the mixture has been dropped.

In 1945 Dr. Heuberger field-tested the reaction product containing zinc ethylene bisdithiocarbamate, coded earlier as He-178. This product was given the trade name, Dithane Z-78, and this chemical has since been assigned the common name of zineb.

Potato pathologists in all parts of the country, where blights were a problem, soon began testing these new dithiocarbamate fungicides. In 1947 a national cooperative potato fungicide trial was organized and these tests were conducted for three years. The new nabam and zineb fungicides consistently gave good control of early and late blight and usually resulted in an increased yield over the copper sprays and other dithiocarbamates. Extension workers and growers themselves have conducted countless tests throughout the years and the early promising results have been generally confirmed. Nabam and zineb are now included among the recommended potato fungicides in all states that regularly issue such recommendations.

Nabam dips and zineb dust treatments have been found useful as potato seed piece treatments for the reduction in losses from Fusarium seed piece decay. These treatments are now recommended to potato growers in many states.

Potatoes have played an important role in the research and commercial development of nabam and zineb, but it was soon learned that these new fungicides were effective on a wide range of disease organisms and that they were extremely safe on a great variety of crop plants. Experiment station tests and grower trials have resulted in substantial commercial use of nabam and zineb on such crops as tomatoes, onions, carrots, cantaloupes, cucumbers, watermelon, celery, hops, spinach, beets, beans, peppers, tobacco, sour cherries, azaleas, roses, and for general purpose garden dusts and sprays. Testing has continued on many other crops in this country and throughout the world. It is felt that some of these more important new developments would be of interest to the potato growers who are now using these new fungicides.

Nabam and zineb are being regularly used for the control of Helminthosporium leaf blights and rust on sweet corn in Florida. Limited quantities have been used for these same diseases on hybrid seed corn in the corn belt states. Research workers in the United States and in Japan have reported successful control of stem rust of wheat and barley with zineb applications. The commercial feasibility of fungicide applications for cereal grains has not been sufficiently demonstrated, but with the serious threat now present from race 15-B of black stem rust to all our presently available commercial wheats, chemical fungicides are of considerable interest as an alternative control measure.

Workers in the southern United States have found that zineb gives excellent control of pecan scab with generally better foliage color and vigor. Nut retention and size are improved, often resulting in increased yields.

Zineb is now well established in several European countries as a fungicide for downy mildew on grapes, scab on apples and the common foliage diseases of vegetables. It is probably of some historic significance that in the spring of 1952 the Rohm & Haas Company started to operate a commercial plant in France for the manufacture of Dithane. This plant

will serve, among others, the area where the long famous Bordeaux mixture was first discovered and used.

Zineb has demonstrated good control of fire blight, a bacterial disease of apples and pears. This work was first reported in Colorado (7) and has now extended to several midwest and eastern apple growing areas where zineb is included among the recommended apple fungicides. Zineb also provides good control of scab, cedar apple rust, Brooks spot, fly speck, frog eye leaf spot, black rot, and sooty blotch of apples, and gives high quality fruit finish and color. Nabam plus ferric sulfate is also finding its way into certain northern apple areas for scab and cedar apple rust control.

One of the more interesting new developments with zineb and nabam has been its ability to control certain soil-borne fungi that cause root rots and wilt diseases of certain crops. Stoddard of Connecticut (6) has shown that soil drenches of nabam on strawberries will largely prevent attack by red stele, a Phytophthora root rotting organism. Other workers have confirmed these results. Introductory commercial trials are now getting under way.

Zentmyer of California (8) has shown a marked reduction of avocado root rot, another Phytophthora species, with soil drenches of Dithane D-14.

Thomas and others in Colorado have obtained substantial reductions in Fusarium root rot of carnations, Fusarium wilt of sumac and Verticillium wilt of lilac with zineb soil applications. (9) Zineb soil treatments have also shown a significant reduction of dwarf smut of wheat in Colorado tests. (2)

Other workers reported promising experimental results with soil applications of zineb and/or nabam for the control of such diseases caused by *Rhizoctonia, Pythium, Fusarium*, and *Verticillium* on cotton, tomatoes, beans and peas. Soil applications of up to 100 lbs. per acre of zineb have shown no apparent deleterious effects on the growth or yield on such crops as tomatoes, potatoes and onions. The evidence from these soil application tests indicates zineb and nabam may work either to disinfest the soil or as a systemic protectant to prevent infection, or both. This very interesting line of research with these fungicides is now being followed by many experiment station workers.

Nabam and zineb have made a major contribution for plant disease control not only for the potato grower but other growers of a great number of commercial and home garden vegetables, field crops, fruits, nuts, and flowers. Nabam and zineb are economical to use, safe to the operator, and present no particular residue hazard on edible crops. They are available in dust or spray form and are compatible with most insecticides. They are effective on many of the important major diseases as well as a great number of the secondary ones. These chemicals are generally safe at fungicidally effective dosages to the blossoms, foliage, fruit and roots of nearly all plants. Their use frequently results in higher crop yields and better quality through good over-all disease control and freedom from injury.

The Rohm and Haas Company is pleased to have had a part in the research and development of nabam and zineb. These compounds were prepared in the company's chemical research laboratories and pilot plant and then submitted to cooperating state experiment stations for laboratory and field screening as fungicides. Gratitude is expressed to the research

and extension workers throughout this country and the world who have conducted hundreds of tests with these new fungicides.

The testing of new dithiocarbamate fungicides is continuing and there are several promising ones now in the experimental or early commercial stages. It is likely there may be better ones in the future. There seems to be little doubt, however, that the ethylene bisdithiocarbamate fungicides have made a substantial and worth-while contribution to the science and art of plant disease control.

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RESULTS WITH VARIOUS CHEMICALS FOR POTATO VINE KILLING[1]

C. R. Skogley[2]

Top-killing the potato crop prior to harvest is a practice that is becoming increasingly popular. In the commercial production of potatoes in the northeast vine-killing is generally considered as an essential operation, mainly for the following reasons: (1) to prevent late blight tuber rot; (2) to minimize the spread of virus diseases; (3) to control tuber size; (4) to permit crop harvest prior to freezing weather; (5) and to minimize labor and expense in the harvesting operation. [1] [2]

Three methods, or a combination of the three, are most often used in killing the potato vines: rotobeating, flaming, and applying chemical sprays. In some instances chemical sprays are applied and then the vines are rotobeaten or flamed. There are many considerations when determining what is the best or most practical system of pre-harvest vine killing. No one method or combination of methods has been proven superior. Any one of the vine killing systems may be satisfactory depending upon the crop conditions and the growers preference or equipment available to him. The cost of each method of vine killing must be considered with the following in mind: Is labor saved as a result of a particular system of

[1]Accepted for publication March 27, 1953. Contribution No. 821 of the Rhode Island Agricultural Experiment Station, Kingston, R. I.
[2]Assistant Agronomist.

vine killing? Is the method satisfactory from the standpoint of disease control? How fast is a kill needed or desired? Is the yield or tuber quality affected by top killing when using a particular method?

From the standpoint of outright cost of performing the operation, station studies indicated that the use of a flame burner would be the most expensive; rotobeating, intermediate; and chemical spraying probably the most economical system.

Vine-killing trials to compare the effectiveness of several different chemicals were started at the Rhode Island Agricultural Experiment Station in 1947. The chemicals, amounts used, and the rates of kill by year, are given in table 1. The rate of kill was based on total vegetation present — both vines and weeds.

TABLE 1.—*Chemicals used in vine killing trials, amounts used, and rate of kill.*

Material	Amount Used Per Acre*	Rate of Kill (Vines and Weeds)** 1947	1949	1950
Aero cyanate	24 lbs.	7	3	..
Ammonium sulfate	300 lbs.	..	..	5
Copper sulfate	30 lbs.	..	..	8
Cyanamid defoliant***	80 lbs.	7	..	..
2,4-D (40% Butyl ester)	1½ qts.	6	..	..
Dow General + fuel oil + Al. Sul.	3 pts. + 3 gals. + 3 lbs.	..	..	1
Dowspray 66 + Al. Sul.	3 gals. + 3 lbs.	1	..	2
Penite 6	1½ gals.	3	1	1
Sinox general + fuel oil	1½ qts. + 7½ gals.	2	2	3
Sodium TCA	75 lbs.	..	7	..
Sulfuric acid	175 lbs.	1	..	..
Tar Acid oil	7½ gals.	..	6	4
Vinetox (Vine kil)	3 gals.	1	1	1
White arsenic + caustic soda	9 lbs. + 22 lbs.	1	..	..

* Applied in 150 gallons of water, except cyanamid defoliant
** Scored as follows: 1 = 100 per cent kill, 10 = no kill
*** Applied as a dust

In 1947 and 1949 the chemicals were applied with a knapsack sprayer to small, replicated plots. In 1950 a commercial potato sprayer was used to apply the materials to single, large plots. The potato variety each year was Green Mountain. Yields were taken each year and samples of tubers were examined at harvest and again at the end of the storage period in March or early April. The purpose of the examination was to determine to what extent, if any, the tubers were affected by the chemical application. The external appearance as well as the amount of stem-end discoloration was observed.

Several of the chemicals tested were not practical because of the amounts required or the danger involved in handling them. A number of others failed to give a satisfactory kill. No conclusion was drawn from tuber examination in regard to the effect of various killers. Slight stem-end discoloration of the tubers was evident whenever a fair to good kill of the tops was obtained. This did not affect quality or the length of time the tubers could be stored. No difference in external appearance was observed as a result of using any chemical vine killer.

The most satisfactory materials used in the tests were the commercially prepared arsenicals, Penite 6 and Vinetox. The dinitro compounds gave almost as good results but required more operations in preparing the sprays. Fuel oil or fuel oil plus aluminum sulfate must be added to the spray when using the dinitros included in these trials. One or two of the other chemicals tested gave good results but were not tested long enough to obtain a basis for making a recommendation.

The two commercial arsenical vine killers listed in the trials were used again in 1951 and 1952, not on an experimental basis, but as an accepted practice on all the potato acreage at the experiment station. The use of these chemicals greatly facilitated the potato harvest. Ten days to two weeks, or longer, prior to digging the materials were applied. By waiting for a short period nearly a complete kill of all vines and weeds resulted. The tubers were mature when dug and did not skin or bruise as easily as would have been the case had the vines remained green nor did the tubers adhere to the vines during digging operations. Killing the grass and weeds also greatly aided harvesting. The soil did not cling to the roots to clog the mechanical digger and picker as is usually the case when the grass and weeds are green. Less labor is required and the equipment can travel at a faster rate when a good vine killer is employed.

Five years of tests and demonstrations at the Rhode Island Agricultural Experiment Station have confirmed the value of using chemical potato vine killers. Although not necessarily superior to other methods of top killing in end results, the use of chemicals is considerably less expensive than either flaming or rotobeating. The two commercially prepared arsenicals gave the best results during the testing period and are among the least expensive chemicals.

Ease of harvesting, protection against disease, and less injury to the tubers at harvest are some of the values to be derived from the use of a good chemical vine killer.

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PRELIMINARY STUDIES ON THE CONTROL OF BACTERIAL DECAY OF THE POTATO WITH ANTIBIOTICS[1]

REINER BONDE[2]

INTRODUCTION

The potato plant is subject to decays caused by the soft-rotting and other bacterial pathogens. Sometimes they cause very extensive losses and entire bins of potatoes may decay in storage.[3] Various bacteria and other organisms also may infect the potato seed pieces or sets resulting in poor stands and reduced crops.

It would be desirable to have a material that can be used for the control of bacterial decay in the storage bin and for the control of rotting of the seed pieces before and after planting.

Experiments were conducted to determine whether antibiotics can be used as treating solutions for the control of bacterial decay of the potato.

CONTROL OF DECAY CAUSED BY SOFT-ROTTING BACTERIUM *Erwinia atroseptica*

Freshly-cut potato slices were treated for 30-minute periods in freshly prepared and 3-day old aqueous solutions of rimocidin sulfate, dihydrostreptomycin sulfate, streptomycin sulfate, and terramycin hydrochloride. (Concentration 30 ppm.) The slices were inoculated with a virulent culture of the blackleg organism *Erwinia atroseptica*[4] and incubated in moist chambers.

The decay caused by this organism is very rapid and symptoms of the disease were apparent on the surface of the potato slices from 12 to 24 hours after being inoculated.

The experiment showed that the rimocidin sulfate solution did not retard or prevent the progress of the soft-rotting organism. The dihydrostreptomycin sulfate and streptomycin sulfate solutions on the other hand were definitely bacteriostatic and the freshly prepared solutions completely inhibited the decay. (See Figure 1.) Terramycin hydrochloride also possessed bacteriostatic properties but to a less extent than dihydrostreptomycin sulfate and streptomycin sulfate.

Of interest is the fact that the inhibiting properties of these antibiotics were lost when the solutions were kept at room temperatures for a period of 3 days before being used to treat the potato slices.

The second experiment was conducted as the first except that 5 other antibiotics were also included in the experiment.

Table 1 summarizes the extent of soft rot that occurred in the potato slices that were treated with the different antibiotics. It can be seen that

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This project was financed in part by a research grant from the Chas. Pfizer & Co., Inc., Brooklyn, N. Y.

[2]Plant Pathologist, Maine Agr. Exp. Sta., Orono, Maine.

[3]Large losses from bacterial soft rot occurred in several potato storage houses in central Maine during the 1952-1953 season.

[4]Culture from Lillian C. Cash.

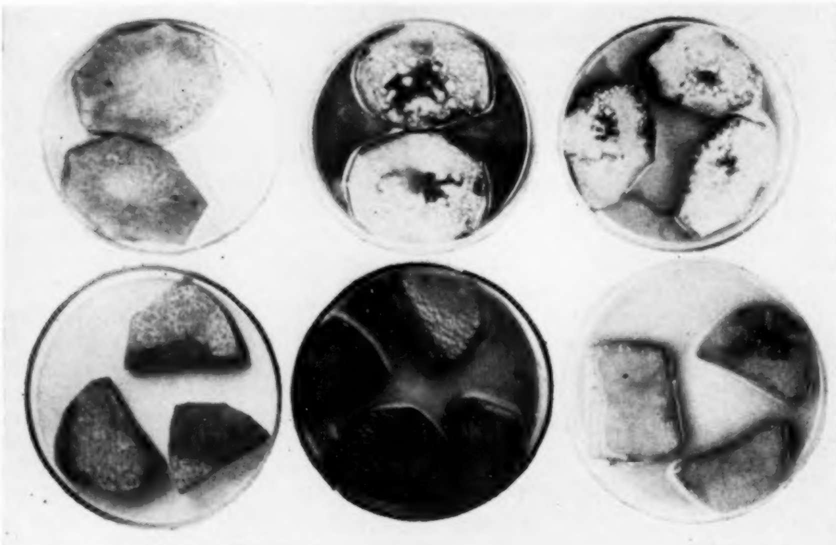

FIGURE 1.—Above, potato slices inoculated with *Erwinia atroseptica*. Middle control. Left, inoculation preceded by immersion in streptomycin sulfate solution. Right, inoculation preceded by immersion in sodium rimocidin solution. Below, potato slices inoculated with *Pseudomonas fluorescens*. Middle, control. Left, inoculation preceded by immersion in aureomycin solution. Right, inoculation preceded by immersion in streptomycin sulfate solution. Note that streptomycin sulfate solution gave protection against *Erwinia atroseptica* but none against *Pseudomonas fluorescens*.

the dihydrostreptomycin sulfate and streptomycin sulfate again gave good control of bacterial soft rot. Terramycin hydrochloride also continued to possess definite bacteriostatic properties but was less effective than the two other antibiotics previously referred to.

The data indicate that potassium penicillin, sodium penicillin, bacitracin, rimocidin sulfate, sodium rimocidin, and thiolutin have no value as seed treatment solutions for the control of the decay caused by the soft-rotting bacterium *E. atroseptica*.

The results of the two previous experiments showed that solutions of dihydrostreptomycin sulfate and streptomycin sulfate inhibit the development of soft rot when used for treating inoculated potato slices. Another experiment was conducted to determine the lowest potency or concentration of streptomycin sulfate that will inhibit the development of the bacterial decay.

Potato slices were treated for 30-minute periods in aqueous solutions containing streptomycin sulfate ranging in concentration from 10 to 200 ppm. The treated seed pieces were inoculated with the soft-rotting bacteria and incubated in a moist chamber for the development of the disease.

The untreated controls became completely decayed as a result of being inoculated. All of the different concentrations of streptomycin sulfate (with the exception of 80 ppm which had a trace) gave complete protection

TABLE 1.—*Comparison of soft rot in potato slices treated by dipping in antibiotic solutions before inoculation*

Antibiotic[1]	Extent of Decay[2]		
	1 day	2 days	Final Per cent Soft Rot
Potassium Penicillin	++	++	100
Sodium Penicillin	++	++	100
Dihydrostreptomycin sulfate	—	—	5
Streptomycin sulfate	O	—	15
Bacitracin	++	++	100
Rimocidin sulfate	++	++	100
Sodium Rimocidin	++	++	100
Thiolutin	++	++	100
Terramycin hydrochloride	—	±	35
Untreated controls	++	++	100

[1]Potato slices immersed for 30 minutes in solutions of concentration 30 ppm.

[2] O = no soft rot
— = slight trace of soft rot
± = soft rot fairly extensive but not rapid
++ = rot fast and very destructive causing complete disintegration of the potato tissue.

from soft-rot infection. Ark, according to Anderson and Gottlieb[5] found that treating potato slices with a streptomycin solution (concentration 1:10,000) greatly reduced the decay caused by *E. carotovora.*

The experiment here reported showed that a streptomycin sulfate solution of 10 ppm will protect freshly-cut potato slices from soft-rot infection caused by *E. atroseptica.*

COMPARISON OF DIFFERENT ANTIBIOTICS FOR CONTROL OF SEED-PIECE DECAY CAUSED BY *Erwinia atroseptica* AND *Pseudomonas fluorescens*

During the course of these studies the question arose as to whether the different antibiotics are specific for the control of the decays caused by different kinds of bacterial organisms. Although the study was rather limited some interesting observations were made.

Potato slices were immersed for 30-minute periods in aqueous solutions of aureomycin, streptomycin sulfate, and chloromycetin of different concentrations. The treated slices were placed in moist Petri dishes and inoculated with virulent cultures of *E. atroseptica* and *P. fluorescens.*[6]

Table 2 gives the extent of decay for the slices treated with the 3 antibiotics and inoculated with the 2 kinds of bacteria.

[5]Anderson, H. W. and Davis Gottlieb. Plant Disease Control with Antibiotics. Economic Botany 6:294-308. 1952.

TABLE 2.—*Comparison of control of two kinds of bacterial decay by aureomycin, streptomycin sulfate, and chloromycetin*

Antibiotic	Potency Ppm	Extent of Decay	
		E. atroseptica[1]	*P. fluorescens*[2]
Crude Aureomycin	20	Complete	Trace
" "	30	"	"
" "	40	"	"
" "	50	"	"
" "	60	"	"
Streptomycin Sulfate	20	None	Complete
" "	30	"	"
" "	40	"	"
" "	50	"	"
" "	60	"	"
Chloromycetin	10	Complete	Complete
"	30	60-70 per cent	"
"	60	30-40 per cent	"

[1]Causal organism of bacterial soft rot and blackleg of the potato.

[2]A common soil organism which may cause a decay in potato seed pieces and tubers.

It is of interest that aureomycin possessed no bacteriostatic properties for the control of the decay caused by *E. atroseptica* but was quite effective for the control of the decay caused by *P. fluorescens* at all concentrations.[7] (Figure 1 below.)

Streptomycin sulfate, on the other hand, did not inhibit the rot caused by *P. fluorescens* but gave complete control of the decay caused by *E. atroseptica.*

Chloromycetin failed to control rot of *P. fluorescens* at all concentrations. This antibiotic failed to control the *E. atroseptica* rot when the potency was 10 ppm. There was slight inhibition when the concentration was increased to 30 ppm and considerable inhibition when the potency was 60 ppm. Chloromycetin was less bacteriostatic for the *E. atroseptica* bacteria than were streptomycin sulfate and dihydrostreptomycin sulfate.

DISCUSSION AND CONCLUSIONS

Experiments were conducted for the purpose of determining whether antibiotics can be used to control the bacterial decays which often occur

[6]A common soil organism; cultures identified by B. A. Friedman.

[7]Other experiments conducted in Maine indicate that terramycin hydrochloride may also have the property to inhibit the rot caused by *P. fluorescens.*

in potato tubers and seed pieces. The results showed that dihydrostreptomycin sulfate and streptomycin sulfate were very effective in reducing the rot caused by the blackleg bacteria *E. atroseptica.* Streptomycin sulfate gave complete control of the soft-rot decay on potato slices following a 30-minute immersion treatment at a concentration of 10 ppm. Terramycin hydrochloride was less bacteriostatic than dihydrostreptomycin sulfate and streptomycin sulfate.

Information is needed to determine whether the antibiotic solutions will control the blackleg disease also caused by *E. atroseptica.*

The reader may ask whether some of the data presented can be applied to treating seed potatoes under farm conditions. The inoculation of potato slices in moist Petri dishes with virulent cultures of the pathogens was much more severe than normally would have occurred in commercial practice. Also, in other experiments not reported in detail here, all of the antibiotic solutions referred to were used for treating freshly-cut seed pieces for periods varying from 30 to 60 minutes. None of the solutions injured the seed pieecs and a perfect stand of normal plants was produced in the field.

The question also arises as to whether potatoes (and certain vegetable and fruit crops) can be treated with solutions of antibiotics for the control of soft rot in the storage bin or in transit to market.

The experiment showed the dihydrostreptomycin sulfate and streptomycin sulfate solutions did not inhibit the decay caused by the soil organism *P. fluorescens.* However, aureomycin, which possessed no inhibiting properties for the soft-rotting bacteria, was effective in controlling the decay caused by *P. fluorescens.* The results indicate that possibly the treating solutions should contain several antibiotics in order to inhibit the different types of pathogens.

ANNOUNCEMENT

The High Plains Potato Conference will be held in Alliance and Scottsbluff, Nebraska, August 21 and 22. All technical workers interested in potatoes are welcome to attend. Write Marx Koehnke, P. O. Box 90, Alliance, Nebraska, for details.

KNIK, A NEW POTATO VARIETY FOR ALASKA[1,2]

C. H. Dearborn, M. F. Babb, and Arvo Kallio

Knik, a new variety of potato, bred and developed in Alaska through the cooperative efforts of the Alaska Experiment Station, the University of Minnesota, and the United States Department of Agriculture, was released to five potato growers for increase in 1952. Knik is a selection from a cross of Arctic Seedling by 56-1 of Minnesota origin and was made by Dr. Z. M. Fineman at the Fairbanks Station in 1944. The ancestry of Arctic Seedling is obscure but circumstantial evidence indicates that it is a direct descendant of the variety Green Mountain. Seedling 56-1 has a maternal parent 75-5 traceable to a cross between Keeper and Silverskin. The paternal parent 15-2 is the product of (Keeper x Silverskin) x Early Ohio selfed and then crossed with Katahdin selfed.

Description

Plants large, erect, predominantly single-stalked, branching at ground level; stems thick, sturdy, rounded; nodes slightly swollen, green; internodes green; wings thick, short, green; stipules small, smooth; leaves medium length, medium width, medium green; midribs pale green, scantly pubescent on upper and lower surfaces; primary leaflets elliptic ovate, medium in size, three to four pairs; secondary leaflets large, few in number, oval, suspended by distinct petioles; inflorescence cormybose on peduncle 5 to 9 inches in length. Flowers 7 to 9 large; pedicels long, sturdy, pubescent; calyx lobes lanceolate, green, pubescent; corolla large, white, showy; anthers large, yellow; pollen abundant; style straight; stigma globose, green.

Tubers long, medium-thick, oval, thickened at bud end tapering to a round, blunt, smooth stolon end. A random sample of 100 tubers ungraded showed the following average dimensions: length 105.8mm., width 69.2mm, thickness 54.4mm. Skin smooth, clear, light cream; eyes very shallow, same color as skin; eyebrows long curved, not prominent; sprouts white when developed in the dark; flesh white, uniform color through cortex and pith tissues; maturity late; and specific gravity 1.0732.

Characteristics

In Alaska Knik (pronounced Kenick) produces more US No. 1 tubers to the acre than the standard variety Arctic Seedling. The tubers are large and very shallow-eyed, have a clear skin and keep well in storage. Skin bruises from handling do not detract materially from the appearance of the tuber because the ground color blends with the skin color. Hollow heart is a rarity even in exceptionally large tubers. Growth cracks have occurred occasionally on the larger tubers but the percentage affected has not been of commercial importance.

The flesh of the cooked tuber is white, mealy when baked and does

[1]Accepted for publication, March 31, 1953.

[2]Journal Paper No. 3. Contribution from the Department of Horticulture, Alaska Agricultural Experiment Stations, Palmer and Fairbanks, Alaska.

not slough when boiled. Although the flavor of the cooked potato is good it lacks the aroma of the Arctic Seedling.

Knik develops a vigorous vine with large white flower clusters but seed ball formation is rare. Since potato vines remain in a vigorously vegetative condition until frozen in the fall it is impossible to predict when the vines of Knik wouud be mature and senescence would begin. Nothing is known of the susceptibility or resistance of Knik to the foliage diseases common to potatoes grown in the States, because foliage diseases alleviated by spraying have not been observed in Alaska since this variety was developed. In the 1952 variety trials, Knik showed nearly as much resistance to common scab as did Ontario. In comparison with the 5 varieties Arctic Seedling, Kennebec, Ontario, Pawnee, Teton and 19 numbered seedlings, Knik was rated second in scab resistance, whereas Arctic Seedling was rated the most susceptible of all commercial varieties.

Knik has been tested in replicated variety trials with 43 commercial varieties and over 100 seedlings at Matanuska and Fairbanks since 1948. In addition, several commercial growers have cooperated in testing Knik. The performance of the 3 Alaska-developed varieties Knik, Arctic Seedling and Alaska in the replicated trials at Matanuska is presented in table 1.

TABLE 1.—*Average yields in bushels to the acre and specific gravities of Knik, Arctic Seedling and Alaska potatoes grown at Matanuska.*

Varieties	Knik			Arctic Seedling			Alaska		
Year	Total	US No. 1	Sp. Gr.	Total	US No. 1	Sp. Gr.	Total	US No. 1	Sp. Gr.
	Bus.	Bus.		Bus.	Bus.		Bus.	Bus.	
1948	458	439	1.0570	402	400	1.0639	519	501	1.0658
1949	544	481	1.0751	475	425	1.0919	470	423	1.0942
1950	548	483	1.0848	510	430	1.0948	330	299	1.0816
1951	493	425	1.0760	510	414	1.0938	449	304	1.0746
Ave.	511	457	1.0732	474	417	1.0861	442	382	1.0790

In these tests Knik has, on the average, outyielded the varieties Arctic Seedling and Alaska both in total yield and in bushels of US No. 1 potatoes. The specific gravity has been on the average lower than that of Arctic Seedling or Alaska. Even with this lower starch content Knik has been rated as a good quality eating potato.

Studies on spacing of seed pieces in the row in combination with 3 or 4 rates of fertilizer applied witl. the planter showed that Knik produced the highest yield of US No. 1 tubers to the acre when spaced at 9 inches and fertilized with 60 lbs. of nitrogen, 240 lbs. of P_2O_5 and 120 lbs. of K_2O. This is a closer spacing than commercial growers are accustomed to using for other varieties in Alaska.

POTATO NEWS AND REVIEWS

INFLUENCE OF THE 400 BUSHEL CLUB ON MICHIGAN POTATO PRODUCTION PRACTICES[1]

D. L. Clanahan[2]

More than three decades ago leaders in the potato industry recognized the stimulating influence of the friendly competition afforded by the 400 Bushel Potato Club. The Michigan 300 Bushel Club, its forerunner in Michigan, was organized in 1922 and honored a total of 10 growers that year for producing more than 300 bushels of potatoes per acre on two acres or more. It continued as a 300 bushel club through the 1950 crop year but has functioned as a 400 bushel club for the past two years. Two acres were the requirements for entry up to 1932 when five acres became the minimum as it is today. Only certified seed growers were eligible until 1929 at which time it was opened to all growers.

3289 Records

To date a total of 3289 records are on file in the Farm Crops Department offices of Michigan State College. The number of records per year has varied from a low of only 7 in 1927 to a total of 319 in 1946. Since changing to the 400 bushel class there were 103 records in 1951 and 154 records in 1952.

The purpose of the Michigan 400 Bushel Potato Club is (1) to encourage the use of the best known and most modern production methods that help insure good yields of good quality potatoes at lower cost per bushel and (2) to honor those growers attaining this record annually. This appears to be the purpose that has withstood the test of time. Other earlier purposes as published indicated the value of the program from the standpoint of its emphasis on certain cultural practices or its value as a demonstration to other growers. This statement of purpose in 1952 is in no way designed to detract from previous good or intent but rather to include and expand its scope.

The Yield Story

Although yield per acre has been the popular item that has stood out through the years, it is not the primary purpose of the club. The motivating exponent of the competitive influence and all other educational factors including the record of the practices followed and their value as a background study of the changes made by the growers through the years is of tremendous importance. The Michigan club has had its share of record yields ranging from the first 500 bushel record of M. E. Parmelee of Allegan County in 1924, to the first 600 bushel record of J. D. Robinson of Emmett County in 1939. The first 700 bushel record was made by Emil DeBaker of Delta County in 1944. Frank Falkeis of Delta County made the first 800 bushel record in 1948 and set a new record for Michigan of 1083 bushels per acre in 1952. However, in 1949 Paul Van Damme of Marquette County made the first 1000 bushel record.

[1]Accepted for publication May 1, 1953..
[2]Farm Crops Department, Michigan State College, East Lansing, Mich.

The annual average yields of potato club members and the state average from 1922 to 1952 inclusive are shown graphically in figure 1. This 30 year period may be divided for convenience into 10 year periods to show the trend in yields by decades. The records show that for the first 10 years of the club's existence the average yield was 343 bushels per acre, for the second 10-year period 376 bushels, and for the most recent or last 10-year period the average yield of all club members was 448 bushels per acre. This is in line with the trends of potato yield records of average production growers which during the same periods were as follows: 89, 102 and 141 bushels per acre, respectively. It does, however, go beyond average producers within the state by several hundreds of bushels. These club members then are the pace makers. Their production methods are worthy of study and deliberation.

Using Good Seed

The records show that never has a club member been recognized who did not plant first quality seed. Most of the records are from growers who used either certified seed or seed not more than one or two years removed from certification. As evidence of the spacing used and size of seed piece the average quantity of seed planted per acre is now running close to 30 bushels. Twenty years ago it was difficult to

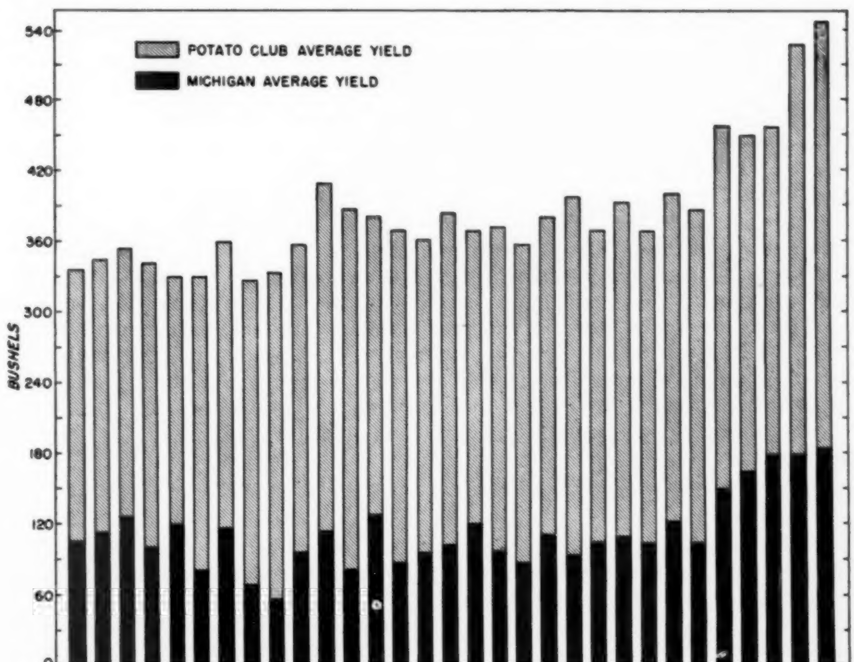

Figure 1.—Average yields of potatoes in Michigan in comparison with average yields 300 and 400 Bushel Club members. Note upward trend in yield in recent years.

find a grower using more than 20 bushels per acre and the average was below that figure.

The general average amount of seed for all potatoes planted in Michigan was 12 to 15 bushels per acre during those early years. Therefore, without the help of generous quantities of top quality disease-free seed the best results cannot be attained in the potato growing business.

Spraying Notes

The original aims of the Michigan Club were to have five sprays applied during the growing season. The early averages showed less than this number of sprays. In fact they did not reach an average of six sprays per year until 1933 and it was 1940 before it became common practice to spray more than six times. The present records show that growers are now spraying an average of 8 to 10 times. Earlier spraying, shorter intervals between sprays, and spraying later in the season for more complete protection has become the rule. Materials used have also come in for changes. Bordeaux mixture was the only spray material used as a fungicide until 1944 or 1945 when World War II put a shortage on copper. One will find the present day grower still using some copper sulphate as Bordeaux mixture, but also the fixed coppers and the carbamates with the latter far in the lead. DDT has completely replaced the old stomach poisons used only a few years ago as insecticides. Parathion is also rather commonly used in control of plant lice, particularly late in the season.

Fertilizing Practices

Early records reveal that the average amount of commercial fertilizer was 300 to 400 pounds per acre with only an occasional grower applying 500 to 600 pounds per acre up to 1940. In fact, four growers out of the first 10 records in 1922 did not use any fertilizer. Today the average has increased to 800 to 1000 pounds per acre with an additional amount of nearly 300 pounds being applied to the sod field the year before or the fall rye green manure crop preceding the potato crop. Also the analysis of the fertilizer is stepped up from the common 2-12-6 and 2-8-10 in the early years to the present day common analysis of 4-16-16 and 3-12-12 or 3-9-18 on the lighter soils. This is in line with the extra plant food actually needed by the higher yields being attained. Is it not reasonable to expect that any grower who hopes for the better yields should consider the higher food requirements for this higher production?

Cultural Practices

The amount of seed used and spacing of the plants for these higher yields was treated previously under the heading of seed, but there remain a few other practices that have a direct influence on better yields. Not the least of these is the seed bed preparation with reference to eliminating other plant competition and avoiding compaction of the soil. Club members again have demonstrated that summer fallowing during the season prior to planting potatoes is the time and way to accomplish these practices. This may require 8 or 10 field cultivations. This was almost an impossible

chore before the tractor became common power on the farm. This is as good a point as is known to inject the influence that power farming has had on the potato industry. It is now common practice to plant these summer fallowed fields to fall rye as winter protection and for the additional green manure that it adds. Potato growers formerly depended on barnyard manure for the organic matter so essential in the program but with the trend of increased acreage per farm this is frequently not enough at present. Michigan growers also know the value of the green rye in helping them to control the common scab.

Fall plowing used to be the order of the day. Now that operation is delayed until just a matter of a few days or even hours before planting. Very little or no working of the seed bed is done after the plowing operation and planting of the seed. The purpose of this is to leave the seed bed as loose as possible for the good of the potato crop. Six to eight row cultivations were common under the older system. Now the average is about two. The weeder has replaced the spike harrow for early blind cultivations to kill annual weeds in their seedling stage.

General Observations

Further comment may seem unnecessary, however, in summary it is difficult not to emphasize again the importance of the cultural practices that make for better yields and better quality at lower cost per bushel. The seed, soil preparation, fertilizing, spraying, organic matter, all are important in doing this job. It is still necessary to harvest, store, grade and package the crop before consumers will part with their dollars to pay the grower for his efforts. The potato grower will need to master all of these before he reaps the benefit of the better living that a good crop of potatoes can give him and his family.

NEW STARCH FACTORY BUILT IN CANADA

Valley Co-operative, Ltd., of Grand Falls, New Brunswick, Canada, organized in 1952, is building a starch factory in Grand Falls which is to have a production capacity of 20 tons of potato starch per day under normal conditions. This factory will be fire-proof, modern in every respect, and equipped with the very latest and best machinery. Highest yields, of potato starch will be produced of the best and most uniform quality, and at lowest production costs.

This co-operative was organized primarily to provide increased facilities for the utilization of cull and surplus potatoes and will have a stabilizing effect on potato prices. —*Charles A. Brautlecht*

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